

## Exercises and Problems for Section 3.2

## Exercises

In Exercises 1–26, find the derivatives of the functions. Assume that  $a$ ,  $b$ ,  $c$ , and  $k$  are constants.

1.  $f(x) = 2e^x + x^2$
2.  $y = 5t^2 + 4e^t$
3.  $f(x) = a^{5x}$
4.  $f(x) = 12e^x + 11^x$
5.  $y = 5x^2 + 2^x + 3$
6.  $f(x) = 2^x + 2 \cdot 3^x$
7.  $y = 4 \cdot 10^x - x^3$
8.  $z = (\ln 4)e^x$
9.  $y = \frac{3^x}{3} + \frac{33}{\sqrt{x}}$
10.  $y = 2^x + \frac{2}{x^3}$
11.  $z = (\ln 4)4^x$
12.  $f(t) = (\ln 3)^t$
13.  $y = 5 \cdot 5^t + 6 \cdot 6^t$
14.  $h(z) = (\ln 2)^z$
15.  $f(x) = e^2 + x^e$
16.  $y = \pi^2 + \pi^x$
17.  $f(x) = e^\pi + \pi^x$
18.  $f(x) = \pi^x + x^\pi$
19.  $f(x) = e^k + k^x$
20.  $f(x) = e^{1+x}$
21.  $f(t) = e^{t+2}$
22.  $f(\theta) = e^{k\theta} - 1$
23.  $y(x) = a^x + x^a$
24.  $f(x) = x^{\pi^2} + (\pi^2)^x$
25.  $g(x) = 2x - \frac{1}{\sqrt[3]{x}} + 3^x - e$
26.  $f(x) = (3x^2 + \pi)(e^x - 4)$

## Problems

In Problems 27–37, can the functions be differentiated using the rules developed so far? Differentiate if you can; otherwise, indicate why the rules discussed so far do not apply.

27.  $y = x^2 + 2^x$
28.  $y = \sqrt{x} - (\frac{1}{2})^x$
29.  $y = x^2 \cdot 2^x$
30.  $f(s) = 5^s e^s$
31.  $y = e^{x+5}$
32.  $y = e^{5x}$
33.  $y = 4^{(x^2)}$
34.  $f(z) = (\sqrt{4})^z$
35.  $f(\theta) = 4^{\sqrt{\theta}}$
36.  $f(x) = 4^{(3^x)}$
37.  $y = \frac{2^x}{x}$

38. An animal population is given by  $P(t) = 300(1.044)^t$  where  $t$  is the number of years since the study of the population began. Find  $P'(5)$  and interpret your result.

39. With a yearly inflation rate of 5%, prices are given by

$$P = P_0(1.05)^t,$$

where  $P_0$  is the price in dollars when  $t = 0$  and  $t$  is time in years. Suppose  $P_0 = 1$ . How fast (in cents/year) are prices rising when  $t = 10$ ?

40. The value of an automobile purchased in 2009 can be approximated by the function  $V(t) = 25(0.85)^t$ , where  $t$  is the time, in years, from the date of purchase, and  $V(t)$  is the value, in thousands of dollars.

- (a) Evaluate and interpret  $V(4)$ , including units.
- (b) Find an expression for  $V'(t)$ , including units.
- (c) Evaluate and interpret  $V'(4)$ , including units.
- (d) Use  $V(t)$ ,  $V'(t)$ , and any other considerations you think are relevant to write a paragraph in support of or in opposition to the following statement: "From a monetary point of view, it is best to keep this vehicle as long as possible."

41. In 2009, the population of Mexico was 111 million and growing 1.13% annually, while the population of the US was 307 million and growing 0.975% annually.<sup>1</sup> If we measure growth rates in people/year, which population was growing faster in 2009?

42. Some antique furniture increased very rapidly in price over the past decade. For example, the price of a particular rocking chair is well approximated by

$$V = 75(1.35)^t,$$

where  $V$  is in dollars and  $t$  is in years since 2000. Find the rate, in dollars per year, at which the price is increasing at time  $t$ .

43. (a) Find the slope of the graph of  $f(x) = 1 - e^x$  at the point where it crosses the  $x$ -axis.  
 (b) Find the equation of the tangent line to the curve at this point.  
 (c) Find the equation of the line perpendicular to the tangent line at this point. (This is the *normal* line.)
44. Find the value of  $c$  in Figure 3.12, where the line  $l$  tangent to the graph of  $y = 2^x$  at  $(0, 1)$  intersects the  $x$ -axis.

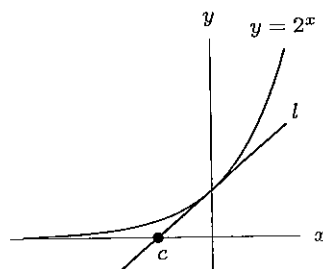


Figure 3.12

<sup>1</sup><https://www.cia.gov/library/publications/the-world-factbook/print/ms.html> and <https://www.cia.gov/library/publications/the-world-factbook/print/us.html>, accessed 4/14/09.

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28, 36,  
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